THE AMERICAN AUTOMATIC TOOL

The reaction of labor-saving machinery upon society is at once the most urgent and the most important of modern social problems—the most urgent because, in even its present development, machinery is acting as a disintegrating social force, and the most important because, lying at the base of our industrial organization, it must eventually alter the fundamental relations of capital and labor.

Accepting fully the increasing values to civilization inherent in the constant refinement of machine processes, we must none the less recognize their equally sinister portents.

It is the purpose of this article to analyze the latest phase of our mechanical development, as expressed in the so-called automatic tool, and to indicate the social problems brought about by it and involved in its extending use.

I

Machinery may be roughly divided into two main groups, the first comprising machines whose principal purpose is to strengthen the arm of the worker, the second comprising those whose purpose is to supplant the worker or to reduce his function to a minimum. All machines falling within the second group may be termed automatic tools.

Although the principle of automatism in machinery is almost as old as machinery itself, yet as a factor in industry it is of comparatively recent growth, dating from about the late eighties. At any rate, about that time there appeared in American foundries an automatic device called the molding machine, designed for the making of iron and other cast-metal articles. Not significant in itself, it yet marked an epoch in the manufacturing industries, for in this machine the automatic principle, which hitherto had been more or less casual, now found a certain place and function.

Up to that time the entire trade of molding had been a skilled occupation, necessitating a long training under apprenticeship. Furthermore it lent itself readily to a high degree of organization

and was so well and militantly unionized as to control the making of all articles of cast metal.

With the advance of the molding machine, however, all this underwent a rapid change. Long training and apprenticeship were no longer necessary in the making of many articles, for a wholly unskilled laborer could, with short practice, turn out a product of a quality equal to the best work of the old-time molder. Thus the new device threw down the gage of battle to organized labor.

It is doubtful whether at that time the potency of the molding machine was at all understood. In general it was looked upon as primarily a means of fighting strikes. Certainly it was not regarded as the herald of a revolution. Yet such it was. Its real importance lay in the change wrought by it in the relation of the worker to his work. Through the course of time and by means of steam power and mechanical improvement of machinery the labor and skill required in the making of commodities had been greatly reduced. But in the main the principle of craftsmanship—of a personal talent, an aptitude for the doing of a particular class of work—had remained dominant in industry. In a certain sense and with few exceptions all earlier machinery was of the simple character which I have described as being but a strengthening of the arm of the worker. The molding machine, operated by the non-skilled, quickly trained laborer, thus became a new force in the unfolding drama of man's mastery of nature and in his evolving social relations.

Through the nineties the molding machine gradually developed and fought its way against the conservatism of employers and the vigorous opposition of union labor. By 1900 it had become a well-recognized tool, capable of making an enlarged variety of articles and many things of intricate and complex pattern.

The principle spread quickly to other applications in complementary trades. So there appeared the turret lathe, the screw machine, the pneumatic hammer, the grinding machine, and a score of other devices, the common effect of which was to afford employment in the manufacturing industries to a class of workers previously debarred through lack of the then usual apprenticeships. Incidentally the quantity of product per worker increased, and its precision and quality improved. As a consequence it made quickly

possible a great increase in production—a sharp advance in man's power to satisfy his expanding wants. It marked one of those abrupt turns of the road in industry which impart to civilization a new direction.

However important may have been the automatic principle as such, the explanation of its rapid development lies in the fact that it established itself coincidently with the automobile; for the automobile was also a revolutionary innovation. It was one of those commodities, or human wants, the general acceptance and use of which seems to explode rather than grow.

The particular relation of the automobile to the final development of the automatic tool is to be found in the enormous and varied numbers of duplicate parts required in motor cars and in the high accuracy required in the making of these parts to insure their perfect interchangeability. The production of any model of car by any large producer involves the making of literally millions of parts that must not vary from each other by the thousandth of an inch. The whole system of service in supplying repair parts, of economical operation in distant places, hinges on this standardization.

A contributing cause to the rapid development of standardization arose out of the novelty of the automobile. It was preceded by no equivalent. It was not an improvement of method in transportation. It was a new means of transportation. It had, therefore, to meet no previous standards, styles, or customs of wide acceptance. So great was the demand that each manufacturer developed his own design and supplied it universally. The same model that he sold in Pekin, Illinois, he sold in Pekin, China. The motor car was the first truly international commodity. It is perhaps within bounds to say that through it standardization first became an international term. How the war acted to emphasize and crystallize this fact is in itself a subject of intense interest, but one which we may not here pursue. It fulfils our purpose to point out that no such multitudinous and exact reproductions of parts as are vital to the automobile had ever before been required. Nor could such quantities have been produced by any machinery known to the nineteenth century.

As a consequence, and under the spur of such an opportunity, in approximately the decade 1904 to 1914, the automatic tool developed into a production power of the highest importance. In the making of motor cars it became and has remained indispensable. Nor is its principle today less indispensable in the making of thousands of other articles of common necessity and use.

II

I have said that the automatic tool introduced into general use a new principle in the manufacturing arts, and that this principle tends to diminish the need of trained skill in the operation of such tools. What then is the principle, and in what way does production under it differ from the old methods?

Automatism in machinery is the incorporation into a tool or machine of a function that previously resided in the operator of the tool. Thus the capacity to do a certain work becomes a function of the tool itself, one to which it conforms without direction by the attendant. An automatic tool is a self-functioning mechanism.

As before indicated, there are degrees of completeness in applications of the self-functioning principle. Some machines are almost wholly automatic, others might be more correctly designated as semi-automatic tools. Thus the use of the pneumatic hammer in riveting requires that the operator possess a considerable degree of skill, though the technique is more easily acquired than the technique of hand riveting. But where the automatic principle is highly developed the sole function remaining to the operator consists in placing parts in the tool and removing them from it. Incidentally he may start the machine and he may also stop it, though in a strict sense these are hardly operating functions, nor do they in any way affect the cycle of the tool's functioning.

It is difficult to make clear in words the utter detachment of the operator from any control over that which the tool does to the thing which he has placed in it. Of a truth, he becomes only an animated derrick. Put in, take out, put in, take out, for sixty minutes each hour, eight hours each day, six days each week, fifty-two weeks each year, under the always imperative condition that he synchronize the movements of his own body with the pre-

determined speed and cycle of the tool. The automatic tool thus attains its highest effectiveness when the human element in its operation has reached the irreducible minimum.

Of course the machine itself and the article or part on which it operates have a very intimate relationship. The material to be worked on, its weight, shape, size, and what has to be done to it, all have a distinct and controlling influence on the design of the tool; but none of these considerations in any way affects the operator of the tool, except as it may require physical adaptability, strength, deftness, or endurance.

As a consequence the automatic tool has depersonalized industry. The ordinary industrial worker of today need have no conception whatever of his work as a whole, nor even the most remote idea of the processes involved in the task at which he is occupied. With none of these is he concerned at all. His relation to his work is often as mechanical, and one might almost say as devoid of intelligence, as that of the locomotive crane to its load.

Yet the automatic tool itself is a superlative expression of intellect. It is made possible only through the co-operative efforts of men having a complete knowledge and practical grasp of every element of applied science in its field. It is the quintessence of mechanical achievement. It is at once master and servant of specialization. It has given into the possession of the few the knowledge which is power. It has imposed on the many that they shall labor only with their hands.

III

It may be proper at this point to discuss somewhat more fully the terms "standardization" and "specialization" as related to the automatic tool. Their industrial meaning is of concurrent growth with the extension of the automatic principle.

Standardization is the term applied to the processes of co-ordinating a product with the machinery and tools by which it is to be produced. It will almost invariably involve considerations of adapting means to an end. For example, the original design of an automobile engine may call for a part having a certain finish which cannot be performed on an existing automatic tool. Can the part be altered, or can a new tool or a new "rig" be devised?

When all has been harmonized on paper there remains the "trial and error" process of actually producing an engine by the means indicated. Only when all this preliminary work has been completed, when the quality of the product has been tested and assured, when the routing and stocking of materials has been arranged and the machinery located, is the factory ready for "quantity production." All this experimental work is a matter of high technical training, of wide knowledge of production, of fine personal skill, in short, of sublimated craftsmanship.

What happens thereafter is simply repetition. Each automatic tool is set to templet or gauge, and for the time being can only do that which it has been set to do. The Iron Man performs the sole bidding of its creators and cares not who impels it to act. The product has been "standardized." The attendant is but a cog.

Specialization is the process of dividing up the functions of standardization. Thus carburetors, magnetos, spark plugs, gears, chain belts, fans, pumps—a score of integral attachments of an engine—each one is itself subject to the same needs of standardization for its production as is the engine on which it is to be used. Yet each such attachment is relatively a small element of the engine. Why not, then, incorporate in the engine design an already standardized carburetor, etc., of proved merit for that type of engine? This is precisely what is commonly done. The standardized carburetor is thus a "specialty" made in a separate factory and by an organization devoted exclusively to its production by standardized methods.

Under the extending influence of the automatic tool specialization treads on specialization. A field for it comes into being whenever a gear wheel, forging, bolt, insulator, or other minor part can be subjected to standardized quantity production. This is the basis of the entirely modern phenomenon of "assembly," from the assembled specialty to the assembled car.

In the last century the specialist was notable; today his absence is remarked.

Virtually all the intricate and complicated industrial processes of standardization, specialization, quantity production, and assembly in the manufacture of ordinary commodities rest on the automatic tool. It has split industry into co-ordinated units of production.

IV

However great has been the effect of the automatic principle up to this time, its future development will be far greater. Specialized standardization, with all its advance, has as yet but made a beginning in American industry. It has extended itself somewhat to England under the pressure of war need. Probably it is much less employed in Central Europe. It has only recently been introduced in Japan. It does not at this time appear to have reached China. Yet there is seemingly no reason why it should not be equally effective as a producing power in all these countries, for its effect is greatly to reduce, if not altogether to eliminate, the potency of the earlier values residing in industrial tradition.

We may therefore confidently expect that in no long time the automatic principle of production must be employed, not only by these nations, but by the smaller industrial countries as well, and that all will strive to widen their applications of it to the greatest possible extent.

For the present, however, it is enough to say that the automatic tool is supreme in its various fields. In these fields it will produce any standardizable commodity for the least sum total of human brain and muscle. And as the totals of brain and muscle put into an article are at bottom its cost, the automatic tool possesses an inherent power to supply us with commodities at the least possible cost.

Moreover, it has increased the ordinary worker's effectiveness both directly and indirectly. The direct increase is in the greater quantity of product which can be produced by the worker while actually working. The indirect increase has a twofold aspect: first, the period of training for the operation of any automatic tool is commonly but a few days or less; while, secondly, its operator requires no general early or preliminary industrial training. It is probably within safe limits to say that today half of all industrial workers can find no possible scope in their work for any vocational training. Hence the ordinary hand worker may enter into the greater number of manufacturing industries at any suitable age without preparation and become practically at once a full economic producer.

As a corollary of great present interest, the mechanizing of functions hitherto residing in the worker has had the vastly

important result of opening the industrial field to a group which has always been debarred from it. Both directly and indirectly it has made place for the lame, the halt, and the blind. The absorption of the cripples of the war has become mainly a matter of adaptation. There will be few whom industry cannot use, and not many whose economic efficiency in adaptable occupations will be even seriously impaired. The same principle is, of course, at the bottom of the sudden irruption of women into the mechanic industries and of their very great success in many departments of the more delicate productions.

Preparation in the sense of apprenticeship, or of technical or vocational training, is now a necessity only to workmen in those classes of industry not subject to standardization, or not yet standardized, and, in standardized industry, to a relatively few individuals who essentially constitute a part of the engineering staff. That is to say, they are included in the group not directly engaged in production.

Thus the automatic tool has created an industrial condition wherein neither academic nor trade education nor craftsmanship, nor the shop wisdom and lore of an industry, nor knowledge of how to read or write, nor even ability to speak the country's language can have any substantial economic value to the great majority of workers. The college graduate, the unlettered Hunk, the irresponsible roustabout, the man and the woman, operating an automatic tool are all on the same plane.

It is this tremendous fact that explains why our Liberty motors —our quintessence of motor product—are perfectly built in large part by men and women workers who have had no sort of education whatever.

What all this means to the workers themselves and its relation to many of the social problems of the day are of course quite other stories.

Are we to consider the automatic principle a permanent force in industry? Or is it only a new and temporary element, mere dross in the crucible that we shall some day skim off? Or should we regard it as an evil that, for the preservation of our institutions, we should suppress? The answer may perhaps be found best in a

question. Would we dispense with the automobile, or the five and ten cent store, or the multitude of things that come to us in tin cans and glass bottles? These and many other commodities of modern life depend ultimately upon the principle of the automatic tool.

The Iron Man multiplies the power of the human man, without need to eat, sleep, or rest. The price exacted is that the human man shall become as but a cog in the functioning of the Iron Man. Like a cog too he must mechanically function with his fellows, putting aside for the time being his human relationships. Mechanical production of commodities has cut off the old human intercourse of industry.

What is the cure? We might perhaps paraphrase Macaulay and say, "The cure for the automatic tool is more automatic tools." The tool has developed and has been developed under relatively restricted conditions. It has been an important factor in the rapid growth of great industrial centers, from which in turn have poured forth the material commodities of civilization. Yet relatively only a few of the people of the world are endeavoring to supply the commodities of civilization to all the world; so they have become slaves of the world through their tool. When all the world supplies itself through the tool the slavery will cease. Under its universal use the toil of each for subsistence will be intensively concentrated in short periods, and we shall thereby earn and distribute that most precious commodity, leisure. But it will be a very different world. Many gods of today will have tumbled, and some of the tumbling may be painful.

Whether we will or no, we must accept the fact that the hand of man has fashioned an instrument of wonderful power for use in his contest with nature, a power that may almost give him the mastery in his struggle for subsistence, a power demanding great intelligence, much knowledge, and keen skill of a few, and no knowledge, little intelligence, and small skill of the many; yet as an inexorable consequence imposing problems of human co-ordination that even now press for solution, problems too that will not accept temporizing or dismissal, problems that are vital to civilization itself.

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